Bruxner Highway Estate-Agricultural Assessment

Lot 42 DP 868366 &
Lot 1 DP 957677
1055 Bruxner Highway,
Goonellabah, NSW 2480
August 2022
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Prepared for:
Nimble Estates Pty Ltd

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EXECUTIVE SUMMARY

Project outline –

Ecoteam has been engaged by Nimble Estates Pty Ltd to undertake an Agricultural Assessment on behalf of their client at 1055 Bruxner Highway, Goonellabah, NSW 2480. The site is proposed to be developed into an estate, which includes 19 residential and industrial lots. The development will take place on an approximately 75.24 ha lot. This document provides information to support a development application for the proposed Bruxner Highway Estate.

Scope of works –

The scope of works for this assessment were guided by NSW Agriculture, Agricultural Land Classification Assessment procedures. The objectives of this investigation are (i) identify and record site indicators and soil profile information, (ii) Assess the site according to the five agricultural land classifications system and (iii) provide an overall suitability of the land for agricultural enterprise. The site was assessed, and landscape and terrain features were mapped. A site investigation, collected site information and extract boreholes in 9 locations, soil was assessed for texture, dispersion, pH and EC. These features were assessed to provide land classification of the dominant terrains at the site.

Summary of Results –

The assessment of the site found three dominate terrains were present at the site. The terrains include; ridges, hillslopes and footslope/gullies. The assessment of the terrain found the ridge to be Class 3 Agricultural Land, suitable for some specialty cropping. The Hillslope were assessed as Class 4 Agricultural Land suitable for grazing, while the footslope/gully areas were classified as Class 5 Agricultural Land not suitable for cultivation or agriculture.

Conclusions and Recommendations –

The subject property contains three main terrain units. These units were assessed according to their constraints to agricultural activities. In general, steep slopes, limited topsoil depth, erosion hazards, boulders and rock outcrops and potential land use conflicts with the creek and drainage lines at the site, make it unsuitable for most agricultural enterprises.

The subject property was found to contain a high portion of Class 5 Agricultural Land within footslopes and gullies. This land type is unsuitable for agriculture, or light grazing. Agricultural productivity is very low or zero as a result of severe constraints, including economic factors. Hillslopes at the site contained Class 4 Agricultural Land which is suitable for grazing but not for cultivation. Although the ridges have potential to be used as Class 3 Agricultural Land for specialty crops such as macadamias, this landscape is limited and only occupies a very small portion of the property.

Contents

1. Introduction

1.1. Project Outline

Ecoteam has been engaged by Scott Anderson of Developed Pty Ltd to undertake an Agricultural Assessment on behalf of their client at 1055 Bruxner Highway, Goonellabah, NSW 2480. The site is proposed to be developed into an estate, which includes 19 residential and industrial lots. The development will take place on an approximately 75.24 ha lot. This document provides information to support a development application for the proposed Bruxner Highway Estate.

1.2. Site Identification

Table 1 contains property details. Refer to **Appendix A** for a site plan of the development. **Figure 1** shows the location on the site.

Table 1. Property details.

Feature	Description
Address	1055 Bruxner Highway, Goonellabah, NSW 2480
Plan Number	Lot 42 DP 868366 & Lot 1 DP 957677
Local Government Area	Lismore City Council
Property Area	75.24 ha
Current Zoning (LSC LEP 2012)	RU1 (Primary Production)
Nature of development	New residential and industrial lot estate

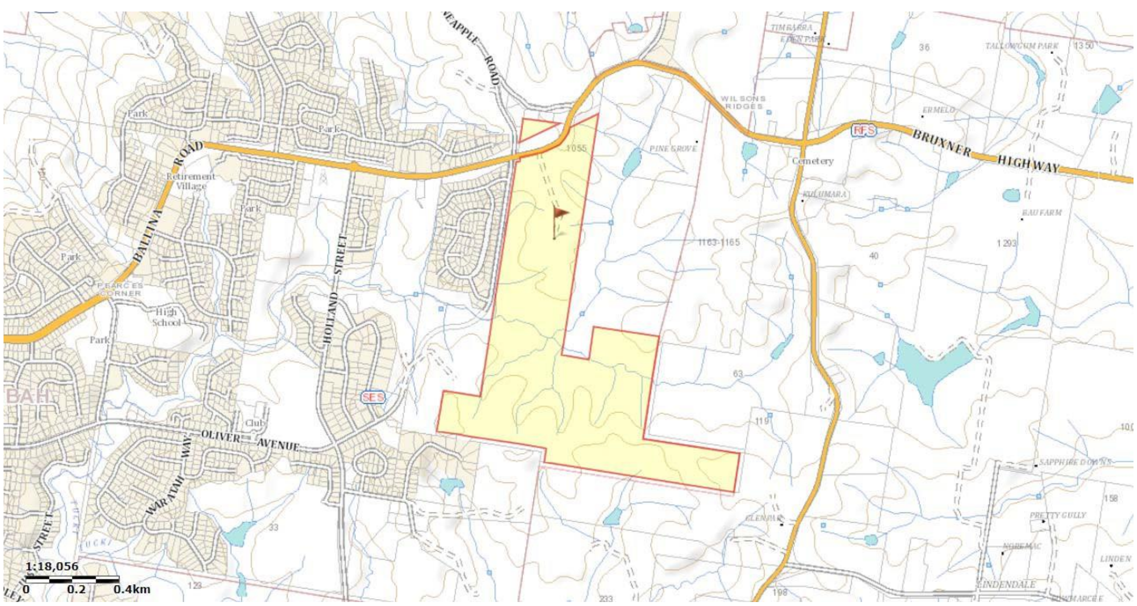

Figure 1. Site location. Property marked with a red flag. Source: Six Maps Online (NSW Spatial Services, NSW Department of finance and Service).

1.3. Scope of Works

The scope of works for this assessment were guided by NSW Agriculture, Agricultural Land Classification Assessment procedures.

1. Undertaking a desktop assessment and mapping of landscape and terrain features;
2. Preparation of a soil sampling programme to adequately assess different land types within the site;
3. Conducting a site assessment of the site to extract soil profile samples to 1 m depth;
4. Undertaking a site assessment of the broader property area to assess site conditions;
5. Providing laboratory analysis of soil layers including soil texture, dispersion, pH and EC;
6. Preparation of an Agricultural Assessment Report.

1.4. Objectives

The objectives of this assessment are to:

1. Identify and record site indicators and collect soil profile and sample information;
2. Assess the site according to the five agricultural land classification system to determine the suitability for general agriculture;
3. Provide an overall assessment of the suitability of the land for agricultural enterprises.

2. Site Condition and Surrounding Environment

2.1. Topography, Geology, Soil Landscape & Hydrogeology

Table 2 contains a description of the regional topography, geology, soil landscape and hydrogeology.

Table 2. Topography, geology, soil landscape & hydrogeology.

Feature	Description
Topography **(eSpade2021, Google Earth 2021)**	Very low to low gently undulating to rolling rises and hills on plateau surfaces of the Lismore Basalts. Slopes 3–15% and relief generally 30–60 m. Altitude is 140-175m AHD m.
Geology **(Morand, 1994)**	Lamington Volcanics: Lismore Basalts—Tertiary basalt with bole and minor agglomerate.
Soil Landscape **(Morand 1994)**	Wollongbar (bg) – low rolling hills on basalt. Relief 30–60 m, elevation 140–200 m. 3–5% on upper slopes and crests to 10–15% on the more extensive sideslopes. Extensively cleared closed-forest of the "Big Scrub".
Hydrology	The subject property forms part of the Wilson River Basin in the Clarence-Moreton Bay GWMA. The site is located near Tucki Tucki Creek.
Acid Sulphate Soil	Not present

Table 3 contains landscape features identified during the site investigation and site walkover.

Table 3. Landscape features identified at AEC during site investigation.

Feature	Description
Vegetation	The subject property contains pasture and some trees. Scattered trees are present in the centre of the property, and along drainage lines. The western boundary contains riparian vegetation along the drainage line. Vegetation is present surrounding the creek.
Buildings and roads	The site contains a main dwelling with additional dwellings and sheds present, these are all not habitable. A gravel driveway is present.
Surface water	Tucki Tucki Creek runs though the property from east to west.
Springs & wells	WaterNSW lists no groundwater wells on the subject property and there are no GW wells located within 500 m of the subject property. (Sources: water.nsw.gov.au, accessed 27/08/2022). One Bore (GW067241) is situated 1 km away from the site)
Flood potential	AEC is above the 1 in 100-year flood. Site elevation is 140-175m AHD.
Acid Sulphate soil	Not present

3. Site Information

3.1. Current Land Use

The subject property is zoned Primary Production (RU1), and it is currently used for cattle grazing. This is consistent with agricultural practices in surrounding farmland, some of which have existing dwellings. The land within the subject property has been extensively cleared, although some regrowth trees remain on site. Three dominant landforms were identified on the subject site: (i) ridges, which is a compound landform element that contains relatively flat land on a narrow crest grading to steeper land to 15% on its adjoining slopes; (ii) hillslope, which contains moderately inclined to steep slopes, and (iii) footslopes/gullies draining into Tucki Tucki Creek.

3.2. Surrounding Land Use

The neighbouring land to the north and west are mixed use General Industrial (IN1), Public Recreation (RE1), and General Residential (R1). The properties to the east and south are mapped as Primary Production (RU1) and are used for intensive agricultural activities including macadamia farming. **Table 4** presents surrounding land use zoning.

Table 4. Surrounding land use.

Orientation	Land Use
North	R1 General Residential,
East	RU1 Primary Production
South	RU1 Primary Production
West	R1 General Residential, General Industrial (IN1), Public Recreation (RE1)

3.3. Proposed Development

The development is proposing to create lots with various zoning (General Industrial (IN1), Public Recreation (RE1), Mixed Use (B4) and General Residential (R1)). The northern portion will consist of mixed-use including units. General residential lots will also be including in this location. The riparian corridor will not be developed and will become public recreation zoning. The southern portion of the property will be developed large industrial lots. **Figure 2** presents the proposed development configuration.

Figure 2. Proposed Development Plan

3.4. State Significant Farmland

The subject site is identified as State Significant Farmland (SSF) in the Northern Rivers Farmland Protection Project 2005 (NRFPP). **Figure 4** presents a map of State Significant Agricultural Land in NSW. The NRFPP contains several criteria for identifying significant agricultural land. When considering the development of SFF, the Interim Important Farmland Variation Criteria contained within the North Coast Region Plan 2036, allow councils to vary the mapped significant farmland boundary, where State or regionally significant farmland is unlikely to contribute significantly to future agricultural production.

SSF and State Significant Agricultural Land (SSAL) are determined based on a Land Capability Assessment. This assessment is very broad in nature. The overall area of land between Alstonville to Goonellabah **(Figure 3**), is considered Class 3 Land (moderate limitations) according to the Land and Soil Capability Mapping (eSpade 2022). Land capability maps are created using a range of input layers which vary in quality. According to NSW DPI (2012), agricultural land maps and not suitable for assessing or rezoning development proposals. This type of mapping relies on 1:250,000 scale data set. The smallest area which can be accurately identified is 250 ha. There are also generally anomalies in mapping because of the various factors used (such as slope, salinity, etc) which may differ to the actual observable land characteristics (NSW DPI 2012).

Therefore, to determine the overall suitability of the subject property for agricultural enterprise an individual land suitability assessment is required which considers actual land features including slope, soil depth and site constraints.

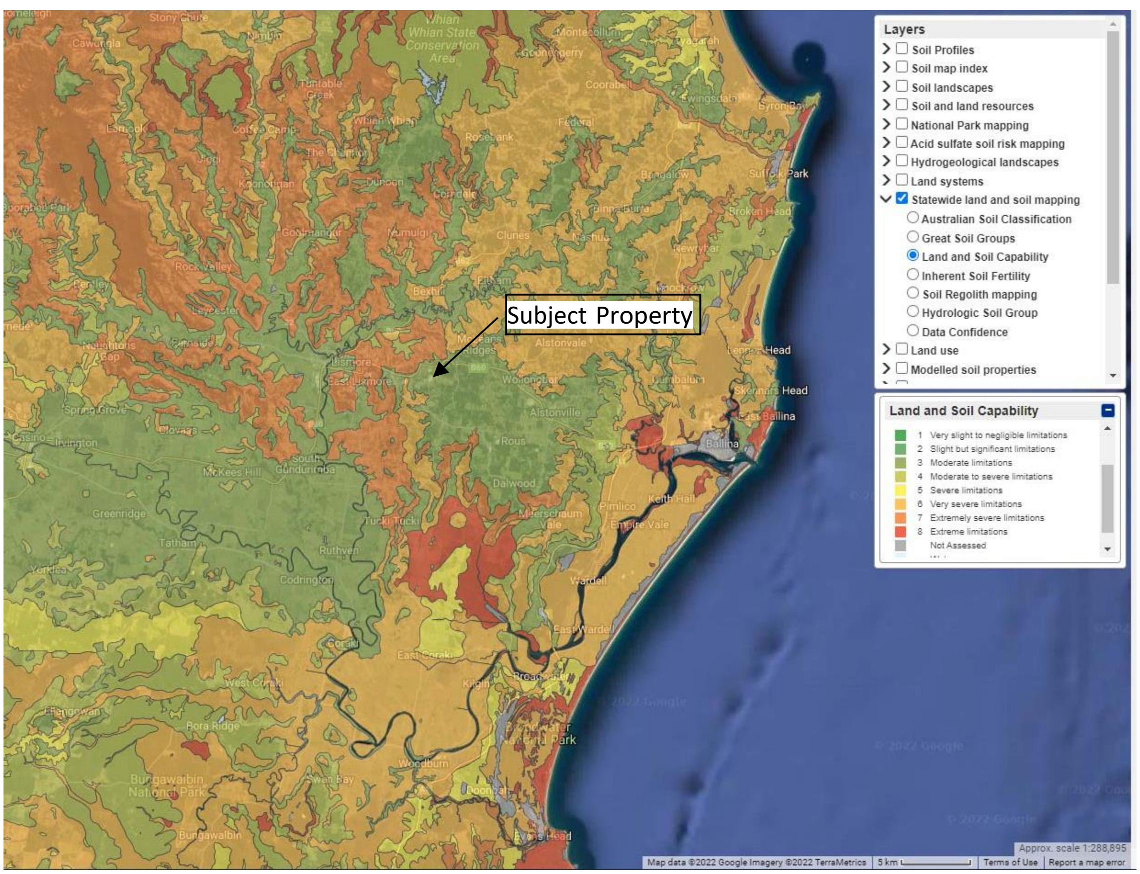

Figure 3. Land Capability Mapping NSW. Source:eSpade (2022)

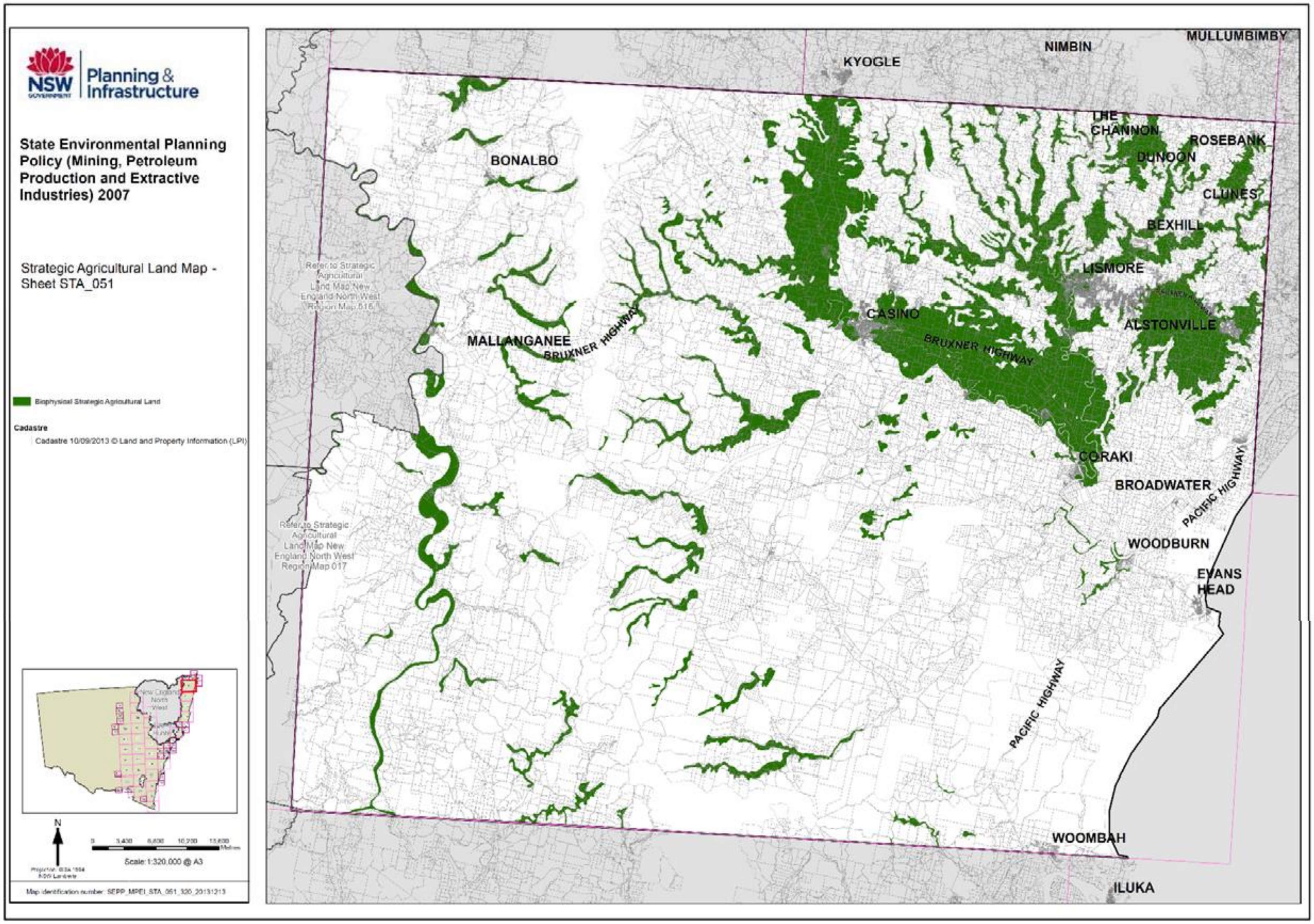

Figure 4. Strategic Agricultural Land Map . NSW DPI

4. Agricultural Land Suitability Assessment

Agricultural land is a limited resource that is experiencing increasing stress from competing land uses and increasing demand for agricultural products. Consequently, NSW Department of Primary Industries (NSW DPI) and its former incarnation NSW Agriculture have developed a technique to classify agricultural land on both a regional and individual farm basis according to constraints to its agricultural productivity (Hulme, Grosskopf and Hindle, 2002; Grosskopf, 1995). The NSW DPI Agricultural Land Classification Technique classifies agricultural land according to the constraints on its agricultural productivity. This system was developed specifically to meet the objectives of the Environmental Planning and Assessment Act 1979, in particular 5(a) (i) 'to encourage the proper management, development and conservation of natural and man-made resources, including agricultural land for the purpose of promoting social and economic welfare of the community and a better environment'.

The technique allocates land into one of five classes which are defined below:

Class 1: Arable land suitable for intensive cultivation where constraints to sustained high levels of agricultural production are minor or absent.

Class 2: Arable land suitable for regular cultivation for crops, but not suited to continuous cultivation. It has a moderate to high suitability for agriculture, but edaphic or environmental constraints reduce the overall level of production and may limit the cropping phase to a rotation with sown pastures.

Class 3: Grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with sown pasture. The overall production level is moderate because of edaphic or environmental constraints.

Class 4: Land suitable for grazing but not for cultivation. Agriculture is based on native pastures or improved pastures using minimum tillage techniques. Production seasonally may be high but the overall production level is low as a result of major environmental constraints.

Class 5: Land unsuitable for agriculture, or light grazing. Agricultural productivity is very low or zero as a result of severe constraints, including economic factors.

The Individual Farm Assessment Technique used for this agricultural classification study relies on a series of constraint tables, and the class of agricultural land is determined by the primary limiting constraint/s. The class thresholds are set at a conservative level and Grosskopf recognises that this method will not cater for all situations. For example, a site with numerous medium level constraints may be classified in a lower class if supported by evidence. The Agricultural Land Classification Study identified and quantified Agricultural land on the proposed concessionary lot. Refer to Grosskopf literature, legislative rationale behind agricultural land classification, the North Coast assessment technique.

Highly productive lands suited to both row and field crops (Classes 1 and 2). Moderately productive lands suited to improved pasture and to cropping within a pasture rotation (Class 3). Marginal lands not suitable for cultivation and with low to very low productivity for grazing (Classes 4 and 5). In addition, a "speciality crop" class is recognised where an area is particularly suited to a single crop or very narrow range of crops, but not to other crops.

5. Study Methodology

5.1. Terrain Characteristics

5.1.1 Slope

Slope was measured using site surveys and GIS analysis tools. A slope analysis is presented in **Appendix B**. Slope was confirmed on site using a clinometer.

5.1.2 Terrain Unit

The terrain unit was identified using field observations and terrain descriptions provided in Grosskopf (1995).

5.2. Soil characteristics

5.2.1 Soil Sample Collection

Three sample stations were selected within each identified terrain unit (**Appendix A**) representing ridges, hillslopes and footslopes. Bores were extracted to a depth of 1 m at 9 sample stations using a hand auger with a bore diameter of 50 mm. Characteristics and depth of each soil layer were recorded and soil extracted from the bores was placed in a profile display unit to photographically record profile characteristics. Soil samples representing each defined layer were collected from the profile display unit, placed in airtight "clipseal" bags, and stored for further laboratory assessment. **Appendix C** present soil profile information, photographs and analysis.

5.2.2 Soil Depth

Soil depth is a measure of soil that is available for root systems of agricultural crops and pastures i.e., the available soil in the profile that will support economically viable agricultural activities. Rocks, impermeable subsoil and hardpans can restrict root development, and therefore restrict the depth of agriculturally suitable soil. Soil depth was established during soil sample collection. The depth of each soil layer was recorded during excavation, and the soil profile in the profile display unit was carefully examined for:

- Physical factors that would prevent the growth depth.
- Root penetration into the profile from existing plants.

5.2.3 Soil Salinity

Soil salinity of the top soil layers was measured by mixing 20 g of soil with 100 mL of water (1:5 soil / water solution) in 300 mL plastic screw top bottles. Samples were thoroughly shaken. Electrical conductivity of the soil was measured using an electrical conductivity meter.

5.2.4 Soil pH

Soil pH of all profile soil samples was measured using a Saturated Paste Soil pH Test Kit developed by CSIRO. Using a small spatula, a drop of dye indicator was mixed with a ¼ teaspoonful of ground soil to achieve a consistent paste. Barium sulphate powder was sprinkled on top of the soil paste, which absorbed the indicator liquid, and changed to a colour according to the pH of the soil solution. The colour of the saturated barium sulfate powder was compared to a colour chart exposed to natural light, allowing measurement of pH with an accuracy of 0.5 pH units.

5.2.5 Soil Texture

The soil texture grade of each profile soil sample was determined according to the method outlined in Cattle (1999). Air dried soil samples were crushed, and, when necessary sieved in 5 and 1 mm mesh soil sieves to extract rock fragments. Water was added to a handful of crushed soil using a hand operated spray pump whilst kneading the soil in the palm of the hand. The bolus was kneaded and homogenised for 2-10 minutes until it reached the "sticky point", which is the point at which the bolus is completely homogenised and it fails to stick to the fingers. When the soil reached the "sticky point", it was rolled into a spherical bolus between both palms. The bolus was slightly elongated, and then a ribbon was created by shearing the bolus using the thumb over the first and second knuckles of the forefinger to produce an extrusion approximately 20 mm wide and between 3-4 mm thick. Ribbons were extruded until the ribbon was not able to support its own weight, resulting in abscission of the ribbon at its base. Triplicate measurements were recorded for each soil sample, and the average ribbon length was computed. Other ribbon characteristics were recorded including the coherence, feel, sandiness, and resistance to shearing. Ribbon length and characteristics were compared to descriptions in Table 1 of Cattle (1999) to determine the field texture grade of each profile sample.

5.2.6 Soil Dispersivity

Soil dispersivity and slaking characteristics was measured using the Emerson Aggregate Test (Emerson, 1967) as described in Soil Survey Standard Test Method EAT P9 B2 (Department of Sustainable Natural Resources).

5.2.7 Soil Type

Soil type was identified by Environmental scientists undertaking soil surveys. During the soil description process, at least 3 soil profiles were extracted to a depth of 1 m using a hand auger with a bore diameter of 50mm. Consideration was given to soil texture, structure, colour, pH, salinity and parent material during the soil type classification. During the soil type identification process, reference was made to landscape mapping, and descriptions in Grosskopf (1995) and Cattle and George (1999).

5.2.8 Drainage

The drainage properties of the soil were identified using a multipronged process:

- Examination of soil layers for mottling. Mottling refers to patches, spots or streaks of subdominant colour which result from differential rates of wetting and drying of a soil layer (Cattle, 1999).
- Examination of soil texture characteristics that will influence drainage such as clay layers and hardpans.

- Conducting a drawdown test on one borehole per terrain unit. 1 m deep boreholes were filled with water, and the water height was measured at intervals during a 5-minute period.

2.2.9 Gravel, Stone and Boulders

Gravel and stone content was measured in the field. In cases where rock fragments represented a significant portion of the soil profile, Samples were collected and sieved through a 5mm mesh sieve to separate gravel and stone from the soil. Each component was weighed using a metric digital scale to determine percentage rock and cobble. Boulder found on-site were noted during the assessment.

6. Results & Interpretation

6.1. Dominant Terrain Units

The subject site contained three dominant terrain units: ridges, hillslopes and footslopes. The ridges consist of a narrow-elongated plateaus and hilltops connected with more gentle adjoining slopes (**Figure 3**). The ridges at the site grades to hillslopes with moderately gradients ranging from around 10% to 30%. The hillslopes grade to foot slopes containing gullies and creeks with lower gradients of 5% to 10%. The majority of the site has slopes above 10 %. In order to comprehensively assess the agricultural viability of the entire proposed development, the agricultural characteristics of each landform were assessed separately. Terrain Units have been mapped in **Appendix A**.

Figure 5. Ridges at the site grading from hill slopes to foot slopes.

6.2. Constraints to Agricultural Activity

Site characteristics and constraints to agricultural productivity for the Bruxner Highway Estate are displayed in **Table 5**. Slope analysis is presented in **Appendix B**. Soil profiles, borehole pictures and laboratory analysis results from the assessment are located in **Appendix C**. Photographs of each soil extraction location is presented in **Appendix D. Figure 4** shows erosion present along hillslopes**. Figure 5** shows the creek and bedrock present onsite.

Figure 6. Erosion present along hillslopes.

Figure 7. Boulders and bedrock situated along the creek and in drainage footslopes.

Table 5. Land constraint Mapping according to site terrain units

Attributes	Land Attribute Values					Ridge	Hillslope	Footslope	Final Class
Land Class	**1**	**2**	**3**	**4**	**5**	**14 ha**	**39 ha**	**22 ha**	**75 ha**
Slope	2-5%	2-15%	5-20%	20-50%	>50%	3	4	2	4
Soil	Clay Loam	Clay loam	Light Clay	Medium Clay	Heavy Clay	2	3	2	3
Soil depth	>150cm	>100cm	>50cm	<25cm	<5cm	3	4	5	5
Soil salinity	<5dS/m	>5dS/m	<10dS/m	>10dS/m	>15dS/m	1	1	1	1
Drainage	Moderately well		Imperfectly	Poor		3	3	2	3
Soil pH	>4.0 (class 1&2)		>3.5	<3.5		2	2	2	2
Sodicity	ESP<10% (class 1,2&3)			ESP>10% (class 4&5)		3	3	3	3
Erosion hazards	Low (Class 1&2)		Moderate	High	Extreme	3	4	4	4
Erosion present	Minor sheet & rill erosion	Minor erosion	Moderate erosion	Severe erosion (class 4&5)		3	3	3	3
Gravel and stone	<2%	2-15%	>15%	>25%	>50 %	1	1	2	2
Boulders, rock outcrops	0%	2-15%	15-25%		>25%	2	2	5	5
Land use conflict	Low		Moderate	High	Very high	2	2	5	5
Actual Land Class						**3**	**4**	**5**	**5**

7. Agricultural Assessment

7.1. Ridge

The ridge terrain was identified as Class 3 Agricultural Land. Its primary limitation is steep slopes connecting the ridges and limited size. The ridge land on the subject site would support the cultivation of some economically viable crops. This is demonstrated by extensive cropping on similar ridge terrain on surrounding land. Speciality crops such as macadamias are suited to this land type. It should be noted, however, that the small size of the ridge on the subject site would generally preclude its use for cropping as access to each location would be limited. **Figure 6** shows an example of a ridge terrain at the subject site.

Figure 8. Ridge terrain at the subject site.

7.2. Hillslope

The hillslope terrain was identified as Class 4 Agricultural Land. Its primary limitations were the steep slopes (up to 30%), erosion hazards, and the very limited depth of arable soil (10 cm). Due to these limitations, the Hillslope is not likely to support any viable agricultural activities. Observations of the surrounding area demonstrate that light grazing activities take place on similar terrain units, however the land does not support cropping. **Figure 7** shows an example of a ridge terrain at the subject site.

Figure 9. Hillslope terrain at the subject site.

7.3. Footslope/gully

The footslope/gully terrain was identified as Class 5 Agricultural Land. Its primary limitations were slope, the limited depth of arable soil (5 cm) and the high incidence of coarse gravel, cobbles and rock outcrops. This terrain is also presenting potential land use conflict with the creek and drainage lines, making it unsuitable for any agricultural activities. **Figure 8** shows an example of a ridge terrain at the subject site.

Figure 10. Footslope/gully terrain at the subject site.

7.4. Quantification of Agricultural Viability

The area of Class 3 Agricultural Land on the proposed development was measured as approximately 14 ha (**Appendix A).** This terrain is well suited to specialty crops such as macadamias, however the very steep hillslopes and rock outcrop footslopes of the subject property make the use of this land for this type of agriculture very limited. The footslopes/gullies on the land which take up a major portion of the landscape (22 ha) are classified as Class 5 Agricultural Land due to poor soil, rock outcrops and land use conflicts with the creek and drainage lines. Therefore overall, the subject property is overall a Class 5 Agricultural Land which is not suitable for agricultural enterprise.

8. Conclusion & Recommendations

The subject property contains three main terrain units. These units were assessed according to their constraints to agricultural activities. In general, steep slopes, limited topsoil depth, erosion hazards, boulders and rock outcrops and potential land use conflicts with the creek and drainage lines at the site make it unsuitable for most agricultural enterprises.

The subject property was found to contain a high portion of Class 5 Agricultural Land within footslopes and gullies. This land type is unsuitable for agriculture, or light grazing. Agricultural productivity is very low or zero as a result of severe constraints, including economic factors. Hillslopes at the site contained Class 4 Agricultural Land which is suitable for grazing but not for cultivation. Although the ridges have potential to be used as Class 3 Agricultural Land for specialty crops such as macadamias, this landscape is limited and only occupies a very small portion of the property.

9. References & Guidelines

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Appendix A. Site map overview and AEC

Plate 1. Site Overview map with terrain units

Appendix B. Site map slope analysis mapping

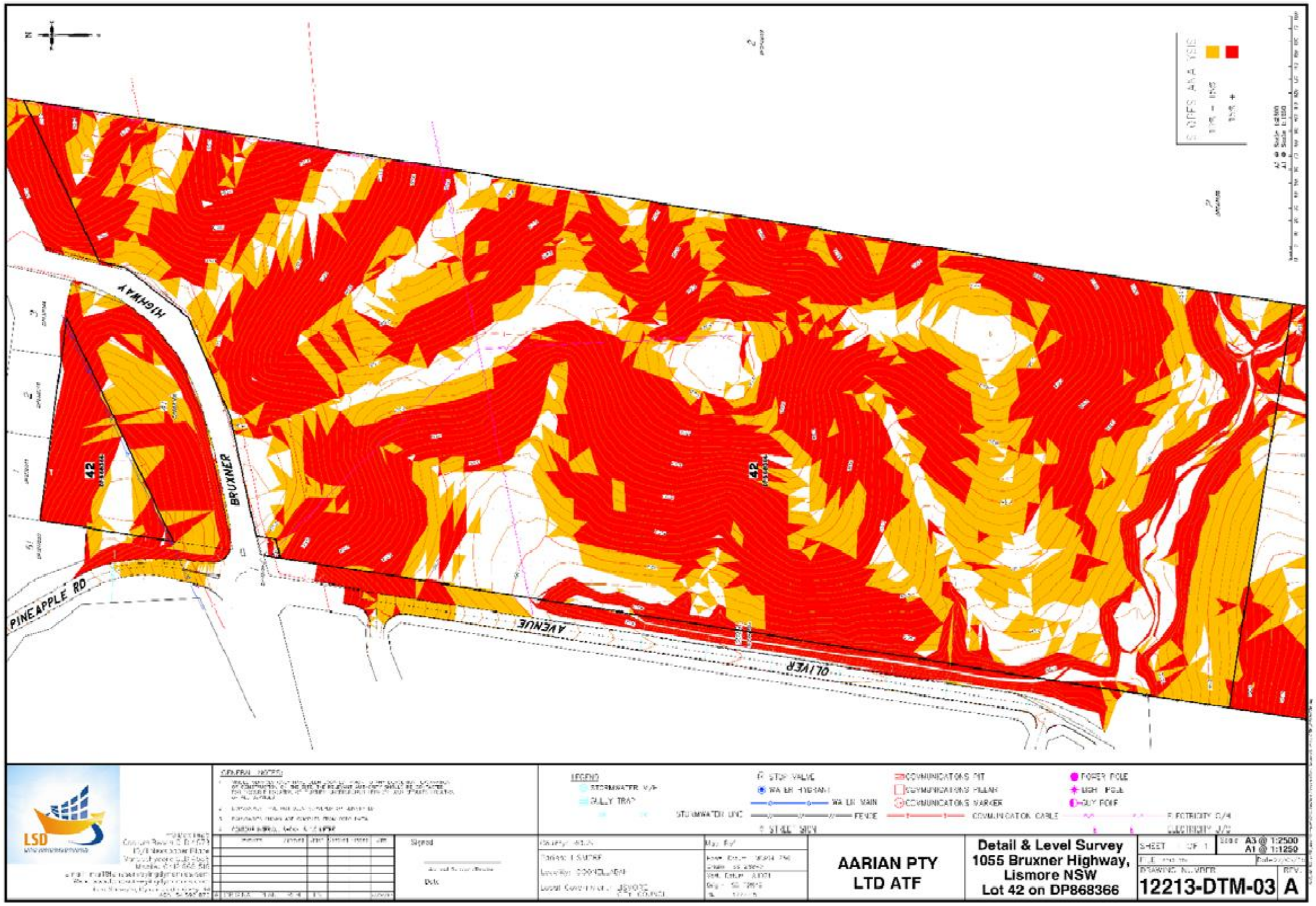

Plate 2. Slope analysis northern portion of the subject site

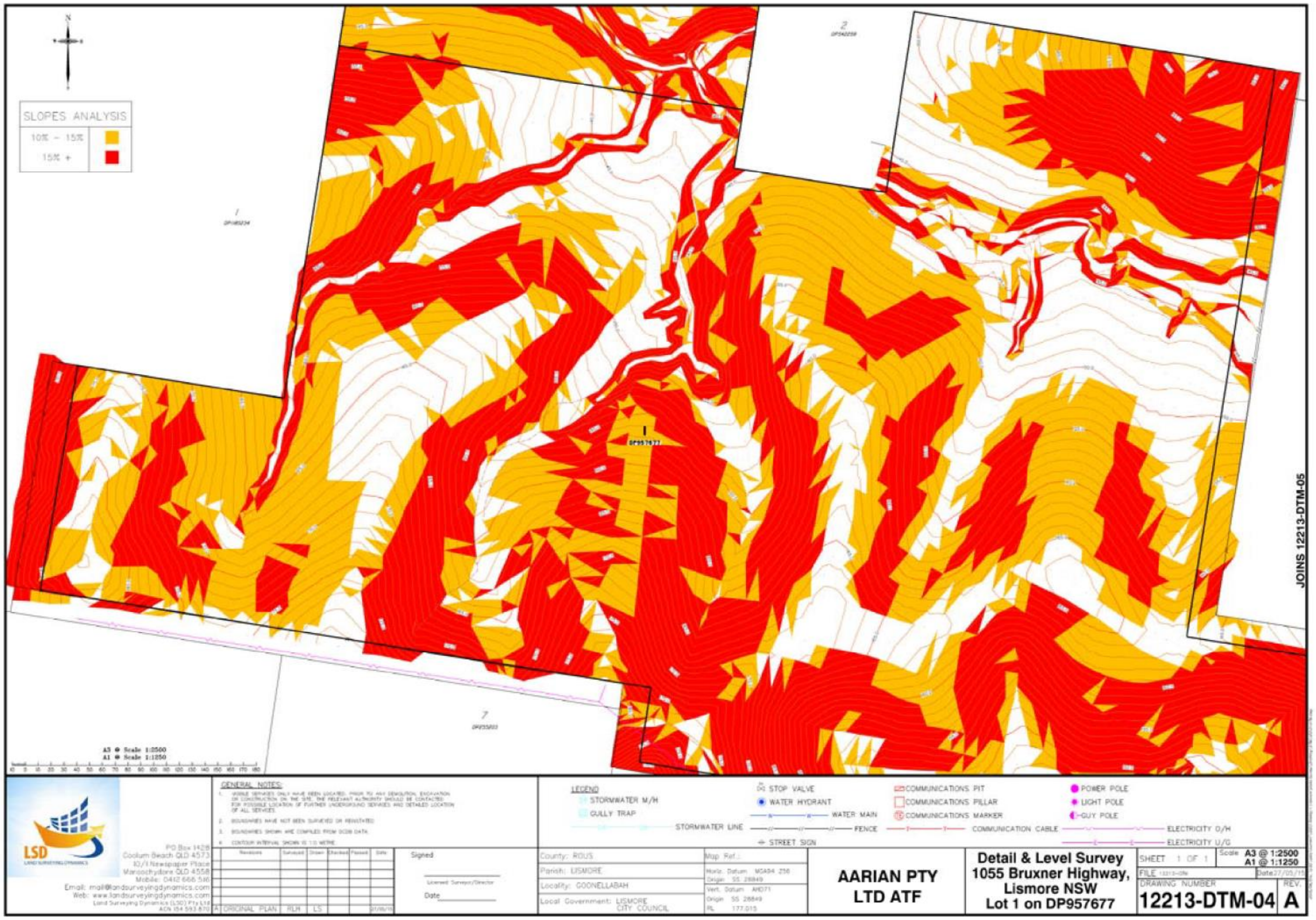

Plate 3. Slope analysis southern portion of the subject site

Appendix C. Soil Borehole Profiles

Ridge

Ridge Line								
Borehole 1								
Horizon	**Depth (mm)**	**Colour**	**Structure**	**Texture**	**Coarse Fragments**	**pH**	**Dispersive Class**	**Electrical Conductivity**
1	0-300	Brown/Red	Strong	Clay loam	<10%	6.0	2	1.12 dS/m
2	300-750	Red	Strong	Light Clay	<10%	5.5	2	
3	750-1000	Red	Strong	Light Clay	<10%	6.0	2	
Borehole 4								
Horizon	**Depth (mm)**	**Colour**	**Structure**	**Texture**	**Coarse Fragments**	**pH**	**Dispersive Class**	**Electrical Conductivity**
1	0-400	Brown	Strong	Clay loam	<10%	6.5	2	1.11 dS/m
2	400-700	Red/Brown-Mottles	Strong	Light Clay	<10%	5.0	2	
3	700-1000	Red	Strong	Light Clay	<10%	5.0	2	
Borehole 7								
Horizon	**Depth (mm)**	**Colour**	**Structure**	**Texture**	**Coarse Fragments**	**pH**	**Dispersive Class**	**Electrical Conductivity**
1	0-200	Brown	Strong	Clay loam	<10%	5.5	2	1.10 dS/m
2	500-600	Red/ Brown	Strong	Light Clay	<10%	5.5	2	
3	600-900	Red	Strong	Light clay	<10%	5.0	2	

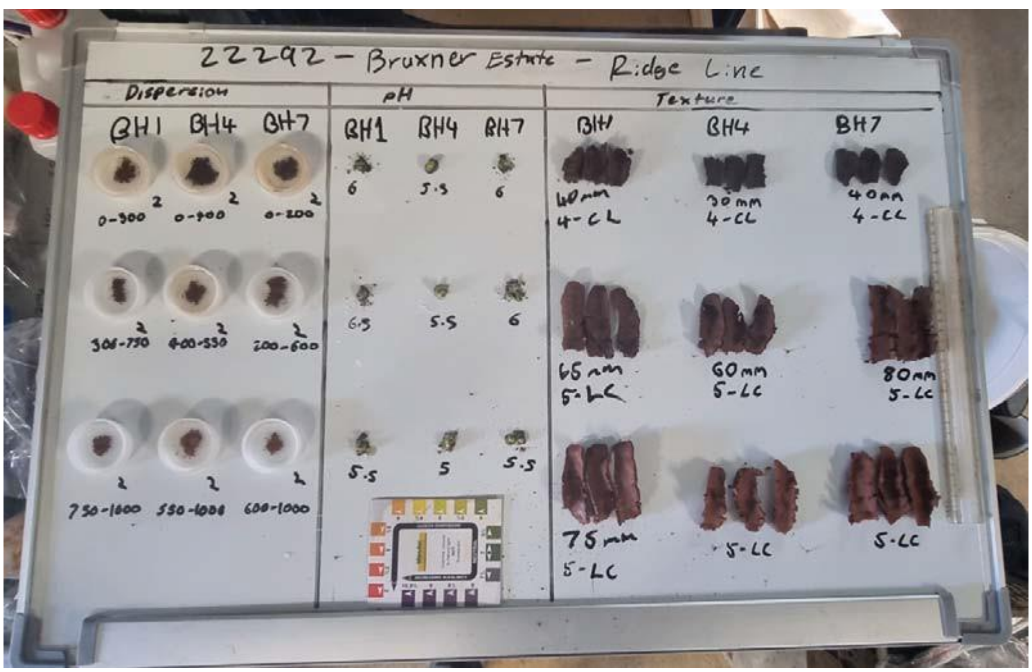

Plate 4. Ridge borehole analysis

Plate 5. Soil bore profile BH 1

Plate 6. Soil bore profile BH **4**

Plate 7. Soil bore profile BH **7**

Hill slope

Hill Slope								
Borehole 2								
Horizon	**Depth (mm)**	**Colour**	**Structure**	**Texture**	**Coarse Fragments**	**pH**	**Dispersive Class**	**Electrical Conductivity**
1	0-100	Brown/Red	Strong	Light Clay	<10%	6.0	2	1.10 dS/m
2	100-400	Red	Strong	Light Clay	<10%	6.5	2	
3	400-1000	Red	Strong	Light Clay	<10%	6.0	2	
Borehole 5								
Horizon	**Depth (mm)**	**Colour**	**Structure**	**Texture**	**Coarse Fragments**	**pH**	**Dispersive Class**	**Electrical Conductivity**
1	0-100	Brown Red/Brown-	Strong	Clay loam	<10%	6.0	2	1.10 dS/m
2	100-800	Mottles	Strong	Light Clay	<10%	6.0	2	
3	800-1000	Red	Strong	Light Clay	<10%	6.0	2	
Borehole 8								
Horizon	**Depth (mm)**	**Colour**	**Structure**	**Texture**	**Coarse Fragments**	**pH**	**Dispersive Class**	**Electrical Conductivity**
1	0-100	Brown/Red	Strong	Light Clay	<10%	5.5	2	1.11 dS/m
2	100-400	Red/ Brown	Strong	Medium Clay	<10%	5.0	2	
3	400-1000	Red	Strong	Medium Clay	<10%	5.0	2	

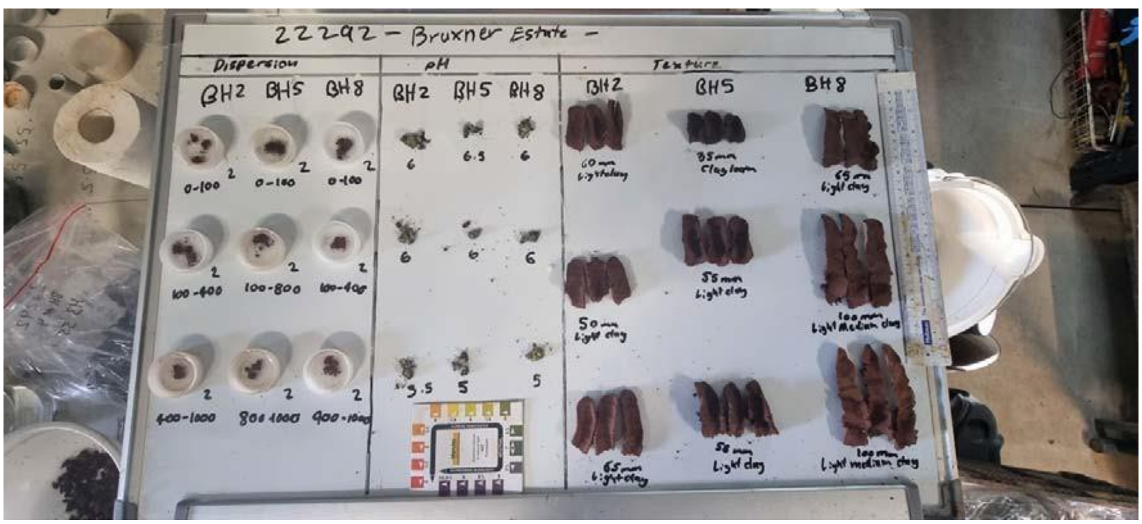

Plate 8. Hillslope borehole analysis

Plate 9. Soil bore profile BH **2**

Plate 10. Soil bore profile BH **5**

Plate 11. Soil bore profile BH **8**

Foot Slope/Gullies

Foot slope /Gullies								
Borehole 3								
Horizon	**Depth (mm)**	**Colour**	**Structure**	**Texture**	**Coarse Fragments**	**pH**	**Dispersive Class**	**Electrical Conductivity**
1	0-50	Brown Red/Brown-	Strong	Clay loam	<10%	6.0	2	1.12 dS/m
2	300-750	Mottles	Strong	Light Clay	5-10% Gravel	5.5	2	
3	750-1000	Red	Strong	Light Clay	<10%-Boulders	6.0	2	
Borehole 6								
Horizon	**Depth (mm)**	**Colour**	**Structure**	**Texture**	**Coarse Fragments**	**pH**	**Dispersive Class**	**Electrical Conductivity**
1	0-50	Brown	Strong	Clay loam	<10%	6.5	2	1.10 dS/m
2	400-700	Red/ Brown	Strong	Light Clay	<10%	5.0	2	
3	700-1000	Red	Strong	Light Clay	<10%	5.0	2	
Borehole 9								
Horizon	**Depth (mm)**	**Colour**	**Structure**	**Texture**	**Coarse Fragments**	**pH**	**Dispersive Class**	**Electrical Conductivity**
1	0-50	Brown	Strong	Clay loam	<10%	5.5	2	1.09 dS/m
2	500-600	Red/ Brown	Strong	Light Clay	<10%	5.5	2	
3	600-900	Red	Strong	Light clay	<10%	5.0	2	

Plate 12. Foot slope/Gullies borehole analysis

Plate 13. Soil bore profile BH **3**

Plate 14. Soil bore profile BH **6**

Plate 15. Soil bore profile BH **9**

Appendix D - Site Photographs

	**Plate 16** Ridge -BH 1 Location
	**Plate 17** Ridge- BH 4 Location
	**Plate 18** Ridge- BH 7 location

	**Plate 19** Hill slope- BH 2 location
	**Plate 20** Hill slope- BH 5 location
	**Plate 21** Hill slope- BH 8 location

	**Plate 22** Foothill- BH 3 Location
	**Plate 23** Foothill- BH 6 Location
	**Plate 24** Foothill- BH 9 location